

POPULAR SCIENCE.

The Transit of Venus.

The Saturday Review states that the English Government has appropriated £10,500 to equip expeditionary corps to be sent out to various parts of the world to observe the transit of Venus across the sun's disc in 1874, and thus aid in the solution of a problem in which all humanity is indirectly interested.

The problem which has to be solved, which the Astronomer-Royal has well called "the noblest problem in astronomy," is the sun's distance from the earth, and it may be well to show at the outset why and how it is thus attacked. It is well known that, to find the distance of any object on the earth from us, it is not at all necessary to walk over and measure the distance; the distance is usually measured mechanically by the interval; it suffices to mark out a much smaller distance, called a base line, and then from either end of this base line to observe the angle between the distant object and the other end of the base. Only one condition is necessary; and, for instrumental reasons, the base line must be of appreciable length with regard to the distance of the object. Such a mode of measurement even may be applied to the moon, which is roughly a quarter of a million miles off, the observations being made, say, at Greenwich and the Cape of Good Hope; the distance between these places the base line—is appreciable when compared with the moon's distance. But when we come to the sun the case is different. If we could place two observers on the equator, one in longitude 0 deg., and the other in longitude 180 deg., we should then have the largest diameter of the planet as the base line; but, compared with the sun's distance, 7900 miles (the earth's largest diameter, and consequently the greatest distance between any two places on it) is instrumentally nil—our base line is inappreciable—and this, the most obvious and direct method, therefore fails.

It is generally supposed that Halley was the astronomer who first pointed out the flank attack on the sun's distance rendered possible by the transits of Venus over the sun's disc; but this is not the case. The suggestion is due to James Gregory, who suggested in 1663 that observations of Venus or Mercury, when they come between us and the sun, and are seen to pass over his disc, may give us the required information. An attempt to explain this will require a little attention. The method is really founded on one of Kepler's laws, by which mankind became acquainted with the relative distances of the planets from the sun long before they could determine their absolute distances. The thing to be done, therefore, is to measure the distance of the nearest planet from us, and then something like a rule-of-three sun tells us the distance sought, i. e., the sun's distance from us. Now the planet which is in its journey round the sun comes nearest to us is Venus, and she comes, as we now know, near enough to us to allow us to apply the base line method, as in the case of the moon, were it not for the unfortunate circumstance that, as her path lies within ours, when she is nearest to us she is between us and the sun, and consequently has her non-illuminated side towards us, so that she is generally invisible at such times. But not always, for sometimes she comes exactly between us and the sun, and appears as a black dot on the sun's face; that is, we have a transit of Venus over the sun.

Now let us see what happens, and let us regard the sun as a screen on which the planet is visible. In the first place, an observer at the centre of the earth would see the planet travelling in a straight line over some part of the disc. An observer at the North Pole would see the planet's path projected lower down on the sun; similarly an observer at the South Pole would see the path projected higher up. In fact, as seen from the North and South Poles, the paths of the planet over the sun would be separated by a certain interval.

Now suppose the sun to be exactly as far from Venus on one side as the earth is on the other, it is evident that the apparent interval between the two paths would represent on the sun a distance exactly equal to that between the two observers; but we know, to start with, that the distances of Venus from the earth and sun are as 28 to 72 nearly, so that the interval between the two paths will always bear this relation to the distance between the two stations on the earth from which they are observed. If it were possible at the same moment of time to photograph the planet on the sun from two distant stations such as we have imagined, the problem would be at once solved, and in this way we could determine the length of the line, as seen at Venus, which joins the two stations on the earth at which the observations are made; we could then increase this in the ratio of 28 to 72, to find the exact separation of the black dots representing Venus on the photographs. Hence we could determine the size of the sun, and hence its distance. But in practice the thing is not so easy, the amount of separation of the apparent paths of the planet over our screen—the sun—can only be laboriously determined from their length, because simultaneous observations are out of the question; and as the difference in the lengths of the paths—that is, the time the planet takes to travel over the sun—is thus the point of inquiry, it is necessary to make this difference as great as possible to give accuracy to the result. From this requirement comes the necessity of choosing the stations at which the transit is to be observed, most carefully bearing in mind at the outset that the earth is a rotating globe—a consideration which complicates the matter to a tremendous extent. Hence it was that Captain Cook went to Otaheite in 1769 on the occasion of the last transit, that Father Hall observed in Lapland, that Mr. Green observed at King George's Island in the South Seas, and so on.

We will give the results of the last, and state briefly the work that has been done in the interval, in order to give an idea of the extraordinary interest which centres in the observations of the one in 1874, for observations of which the arrangements will require to be begun at once. If we take up "Ferguson's Astronomy," an admirable book written about the middle of the last century, we shall find it roundly stated that the earth's distance from the sun is 82,000,000 miles. The first transit of Venus, in 1769, brought this up to 95,173,000 miles, a number so near the one obtained in the next transit, that of 1769, that till quite recently some foul play was suspected in the observations made in the last-named year to render the results similar. Fortunately, however, we are now no longer dependent upon transits of Venus. Our instrumental means are now so greatly improved that we can apply the base line method to Mars, and, not to mention other means, even the velocity of light has been brought to bear on the problem; and, singularly enough, the result of all this modern work of more indirect methods has been to show that the value of the distance derived from the observation of the transits in the last century requires to be reduced by something like 4,000,000 miles. It might be im-

agined from this high number that the astronomers were egregiously at fault, but the delicacy of the problem must be borne in mind. The error they made in the sun's angular diameter, granting it to be an error, is no greater than the breadth of a human hair viewed at a distance of 125 feet.

But this is not all. Soon after the concordant results of all this work had so satisfied astronomers of the necessity of reducing the received value, Mr. Stone, of the Greenwich Observatory, carefully and wisely going over the old work in order to be able to direct the proposed observations, found that an excessively curious phenomenon, to which we can only refer, observed at the transits, had been taken into account, the value of the sun's distance obtained by the transit of 1769 was marvellously concordant with the recently determined value. Mr. Stone has received the gold medal of the Royal Astronomical Society for this research, and well he deserves it. The conclusions at which he has arrived will enable the observers of the approaching transit to obtain results of the last degree of accuracy.

Disappearance of the Dog Star.
A most startling astronomical fact, the explosion, or rather the conflagration, of Tan Coronæ occurred some time since. It appears now that another and much more important star is slowly taking itself out of our system. By calculations of extraordinary minuteness and delicacy, Mr. Huggins and another astronomer have demonstrated that Sirius and our sun are mutually receding from one another at the rate of 20 1/2 miles per second. In the end, therefore, though the distance of time strains the imagination, we must lose sight of Sirius—that is to say, provided we have not by that time gained the capacity of watching the more distant universe towards which he must be receding—an improbability. Nothing seems so near its final limit as the power of astronomical telescopes, while the power of the human eye, if it alters at all, probably decreases.

A Solar Steam Engine.
M. Monchot is at present exhibiting, in Paris, what he calls a solar steam-engine—an exceedingly interesting piece of mechanism, the novelty and ingenuity of which are equally striking. A spherical mirror, or reflector, of a hollow form, plated with silver, is placed in a position to receive the full strength of the falling sunbeams, the intensified heat of which is communicated to a boiler formed of glass or crystal; the water contained in which boils after the lapse of a few minutes, and the steam, playing upon the piston, sets a small engine in rapid motion, which, in turn, moves an Archimedean screw, which forces a body of water up a considerable height. The inventor entertains sanguine hopes that his machine, once constructed to work on a large scale, will be universally preferred for all industrial operations in intertropical countries, where the ardent rays of the sun, for eight months in the year, will insure regularity in working, and constitute for them the most economical motive power. It remains to be seen whether operations on a large scale will be as brilliantly successful as the experiments at present performed by the ingenious model. Opinions are much divided concerning the practical working qualities of the invention, some maintaining that it is only an interesting toy, and others that it is destined to operate another revolution in the walks of science and industry.

Meteors in Scriptural Times.
Mr. Ed. L. Garbett writes to the *Spectator* in reference to the destruction of the cities of Sodom and Gomorrah, maintaining that the Cities of the Plain were destroyed by a crowded group of the sodio-magnetic meteors known to be following Tempel's telescopic comet of January, 1846. Now the chances to be considered were those for the following six coincidences:—1. That the comet deduced from the node-passages of the comet's only observed visits, the Chinese of 1366 and ours of 1866, would give a visit in the winter between B.C. 1898 and '97, in one of which years the catastrophe is dated, consequently in the right biennium out of 16; 2. That the earth's passage of the node was then about July 31, and the event was in a hot season (when Abraham needed shade at noon, and the visitors proposed abiding in the street all night). Suppose this applicable in Palestine to half the year; then we have the right half-year out of 2; 3. A fall as vertical as rain ("then the Lord rained") was possible, from this source, in no hour but that of sunrise. Hence we have the right hour out of 24; 4. Dividing each hemisphere (say) into 8 zones of latitude, the degree of verticality was possible in none of those but the third north. Hence we have the right latitude region out of 16; 5. Sodium, the chief element in the abnormal deposits now there (and in the salt said to have buried Lot's wife) was also the chief observed by Browning and Secchi in these meteors; and is not the chief in one-thousandth of the matters on earth. But let us suppose a twentieth of all known matter to display it as prominently as the meteors did; then we have the right chief element out of 20; 6. Magnesium, the second in those salt deposits, was the only other ingredient conspicuous to Browning or to Secchi; and though stands higher in the order of known abundance on earth than sodium, it would not be thus conspicuous in the known solid of ten. Hence we have the right second element out of 10.

Now, suppose any event not due to this comet to be recorded. The chances against the account presenting those six agreements with its elements, and no disagreement, are found by deducting 1 from 16 x 2 x 24 x 16 x 20 x 10. In short, the discoveries of these three years have made it three millions to one that the history of Sodom is true, and this the physical cause. Now, I do not call that scientific "certainty," but it will not be easy to find in meteoric science a result resting on much stronger evidence.

A correspondent says—"Supposing this statement to be correct, there is an incident which tends greatly to confirm it. It will be observed that the interval between the two observations is 500 years; now just 1000 years after the destruction of Sodom, in the year that King Abrahah died, B. C. 897, we find it recorded that he descended from heaven, 'upon the top of a hill,' at two different times, and each time consumed a captain of fifty with his fifty."

Penit, the Texan.
A report has been circulated that Major John H. Pratt, the reputed Texan fugitive and assassin, whose case recently came before the United States and State Courts, in this city, in a very conspicuous manner, has temporarily taken his residence in Europe. It is known that he became frightened, and started on a voyage abroad about five days after his release by the United States Commissioner, departing from this port in a sailing vessel, under a feigned name. It is believed that his position as an officer of the Memphis, El Paso and Pacific Railroad, and his other business pursuits, will not permit his remaining away from the country for any extended time. Should he attempt to return, however, he is like to be re-arrested for murder, so strong is the feeling against him in his native State, where his crimes are alleged to have been committed.—S. F. Times.

GENERALITIES.

The Cause of Fessenden's Death.

From the Portland Press.
A post-mortem examination of the body of Senator Fessenden was made on Thursday morning. It was found that just above where the smaller bowels enter into the larger the canal had contracted so as to be entirely closed, and the bowels for a foot or more above the obstruction were in a high state of inflammation. A perforation was also found above the obstruction, and it was the opinion of the doctor, that at the time he was called the doctor, on Tuesday, the 31st day of August, he made this rupture, and that human skill could avail nothing towards saving his life; and that had he been called more above the obstruction were in a high state of inflammation. 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